HOSPITAL AND MEDICAL FACILITIES SERIES
(Under the Hill-Burton Program)

design equipment

guidelines for

HOSPITAL MODERNIZATION

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE / PUBLIC HEALTH SERVICE

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FOREWORD

Hospital modernization grants, made possible by the 1964 revisions to the Hill-Burton legislation, mark a change in emphasis to meet new needs. But basically the objectives of the program remain the same: to assist the States in providing adequate health facilities for all of their people.

Conditions have changed, however. Today we are no longer confronted with the critical hospital shortage that led to the inception of the Hill-Burton program. Rather, it is a problem of functional or structural obsolescence in the large urban hospitals that are expected to provide specialized services, high quality care, the most advanced medical procedures, and opportunities for training and research.

A 1960 study, conducted on a sampling basis by the Public Health Service in cooperation with State Hill-Burton agencies, revealed that it would cost at least $3.6 billion to modernize and replace obsolete health facilities without increasing the total number of beds. The needs probably exceed $4 billion today, and in the general hospital field alone, the modernization requirement totals more than $3 billion.

To help meet modernization needs, the Congress has authorized the appropriation of $160 million over a 3-year period beginning with fiscal year 1966. The priority for allocation of these funds is based not only on population and financial need but also on the extent of need for modernization.

The guidelines presented in this publication have been prepared to assist hospital administrators in determining whether modernization will solve the problems facing a particular facility in its efforts to provide better health care to the people of its community.

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Guidelines for HOSPITAL MODERNIZATION

In this article on hospital modernization, a federal official tells how to evaluate an existing plant and how to determine whether modernization of a facility is economically feasible

August Hoenack

THE Hill-Harris amendments to the Hill-Burton Act (the Hospital and Medical Facilities Amendment of 1964) focused attention on the need for modernization or replacement of public and private nonprofit hospital and other health facilities, particularly where the greatest need exists — in densely populated areas. The legislation authorized the appropriation of $160 million from fiscal 1966 through 1969 for this purpose.

Many large hospitals in urban areas are becoming obsolete and increasingly inefficient to operate. Yet these hospitals provide specialized services, set standards of quality care, conduct research, apply the latest advances in medical science, and train future health specialists. In recognition of the important role of large hospitals, the revised act provides that the allocation of funds for modernization or replacement shall be based not only on population and financial need but also on the extent of need for modernization.

Hospital administrators, boards and building committees need a better understanding of some of the problems they may encounter in modernizing old facilities. This article is not intended as a complete check list of all the factors to be considered in modernization but rather should be used only as a guide to preliminary programing. Detailed planning and programing for modernization must be done by the hospital board or building committee with the help of experienced architects and engineers.

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The Problem

Hospital buildings, because they are complex, tend to become obsolete sooner than many other types of building. Physical obsolescence of a hospital is caused by deterioration of the structure, including materials and finishes, and by deterioration or overtaxing of the mechanical and electrical plants. If maintenance has been poor, physical obsolescence is accelerated. Functional obsolescence results from changes in (1) medical concepts and practices, (2) the use and organization of hospital departments, and (3) the neighborhood served by the hospital (*e.g.*, the change from residential to commercial or industrial).

Physical Obsolescence: Deterioration of the hospital structure and mechanical and electrical systems affects not only the strength and weatherability of the building but also the comfort and safety of the staff and patients. Even with good maintenance, finish materials eventually have to be replaced. Any plant, however well cared for, will probably lack many physical features that are considered essential in present-day hospitals. Column locations, window arrangement, corridor widths, and similar physical characteristics in existing buildings may preclude an ideal rearrangement of space for the needs of a hospital today.

Mechanical requirements increase with the growth of hospital services and practices, and the originally designed mechanical plant may not meet these requirements. Nor will it probably satisfy the needs of new equipment and today's requirements for ventilation and air conditioning.

The electrical requirements currently considered minimum in a hospital will probably exceed the existing electrical load capacity of most old hospitals. The increased use of air conditioning and the needs for emergency electrical service will no doubt contribute to the obsolescence of the electrical system.

New fire safety concepts will probably require additional means of egress from the hospital. Stair towers, horizontal exits, and approved doors may have to be added to provide basic fire protection, even though the main structure and partitions may be considered generally fire-resistive.

Functional Obsolescence: Unfortunately, a hospital that has had excellent maintenance and has deteriorated only slightly can still be functionally obsolete. Drastic changes in hospital use are forcing radical changes in the organization of some departments. Most hospitals find it difficult, if not impossible, to fit the additional services that have become their responsibility into existing envelopes, and additions are usually

necessary for the increased fonctions.

A hospital located in an area that has become commercial or blighted may also suffer from functional obsolescence. In this situation, often the site must be abandoned and the hospital relocated.

Probably one of the most difficult problems for the hospital board is to appraise the facility's needs realistically. The board may feel that if only another room is added to x-ray, a few rooms rearranged to enlarge the outpatient space, and air conditioning is put in all the rooms, the hospital can operate for another five years. However, as the contractor gets into the construction phase, he may find that portions of the mechanical system need replacing, or that new equipment contemplated and perhaps purchased cannot be used with existing electrical or plumbing systems.

Building committees also tend to overlook the damage done to finishes by general renovation work and the difficulty in matching finishes. These situations are difficult and costly to cope with when they arise during the construction phase. Therefore, a well-planned, realistic program is essential to any modernization project.

An extension and remodeling project should be programed in much the same way as a new facility would be programed. The hospital must evaluate its future role in the community and the facilities and services necessary to carry out this role. The program should be complete in terms of the kinds of space needed, the square foot area, the equipment to be used, staffing, patient loads, and all the data that ultimately will be needed for the building program. The whole facility should be comprehensively programed without anticipating the possible compromises that may have to be made because of limitations of existing buildings.

Programing should also consider long-range planning. The board or planning team must anticipate future needs that as yet may not have become evident in the activities of the hospital. The needs that cannot be met immediately because of limited budget and other factors must also be considered.

Modernize or Build?

After the project has been outlined and a complete program has been written, the building committee or board must then decide how best to meet the objectives of the program — whether to modernize the present facility or build a new facility. The hospital building committee or board must find answers to many questions when deciding on the course of action to follow.

One of the initial questions that should be considered is the future role of the hospital in relation to the overall metropolitan area program, if one has been developed, for providing adequate health facilities and services to the population. This may affect not only the location of the hospital but also future services which should be provided. Additional questions include the following:

1. Is the hospital still located in the right place to be of the most service to the community?
2. Does zoning protect the hospital from future undesirable encroachments?
3. What is the potential of the existing plant for economical and functional renovation and expansion?
4. Is it economically sound to modernize or would it cost less in the long run to build a new facility?
5. Is the present site large enough, or can additional land be acquired, for the immediate and future expansion?

A metropolitan areawide hospital planning council, if one exists in the area, can be of assistance to the hospital board in answering some of these questions.

A detailed feasibility survey of the existing plant will be necessary to provide the detailed information that will be required before a decision can be made on whether the existing hospital should be modernized or a new hospital should be built.

The feasibility survey must be made by experienced architects and engineers and would usually include evaluation of the site, the architectural layout, the mechanical plant, the electrical system, structural and fire safety considerations, and construction and other costs. This survey in most instances will produce schematic plans, a general program of how the project can be expanded, a cost estimate, and a schedule of building operations so that disruption of the hospital operation will be minimized during construction.

The hospital board should consult with the architect to determine how extensive the survey should be to give the necessary information on the condition of the physical plant.

Site Evaluation: In many instances, facilities cannot expand because of site limitations. Plans should be made for gradually acquiring adjacent land if this is possible. Hospitals that remain in older communities have found it necessary to provide onsite parking since it has become increasingly difficult for automobiles to be parked in the neighborhood. Several recent articles on parking apply quite well to the hospital that is planning to expand.[1]

The evaluation of the site should provide answers to the following questions:

1. Is the site large enough to permit the expansion now contemplated?
2. Will it be large enough to allow for future expansion?
3. Are parking facilities available on or near the site to accommodate the number of people the expanded facility will serve?
4. Will the topography of the site allow the required expansion?
5. Will the capacities of the mechanical and electrical entrance services now in use carry the increased load caused by expansion? If not, are additional service lines or capacities easily available?
6. Do service roads, bypasses and throughways allow for easy accessibility to the hospital by the clients it will serve?
7. Are public transportation facilities available to the site?

Architectural Layout: The architectural feasibility survey should determine exactly how the facility can be modernized to carry out the program that has been developed. Existing departments and spaces in the hospital should be carefully studied to facilitate the proper functional arrangement of the anticipated remodeling and expansion. If they are available, original drawings and "as built" drawings will be valuable in the architectural evaluation, although old drawings are not always dependable. If these drawings are not available, it may be necessary to prepare an architectural layout of the existing buildings.

Usually the square foot area of the existing space is inadequate and con-

[1]Balsley, Marie: Parking for Hospitals — Part 1. Hospitals. 38:82 (Oct. 16) 1964.

siderable space must be added. Consequently, it is desirable to house areas such as surgery, x-ray and laboratory in a new wing. This permits the architect to design a better functional arrangement for these areas and also helps in the matter of scheduling the construction so that the existing facilities in the hospital can be used while the new wing is under construction. Under these circumstances a somewhat more extensive addition may be more economical.

Some of the questions the architectural survey should answer are:

1. Can the volume of the existing plant absorb the expanded services envisioned by the program?
2. How much remodeling must be done?
3. How much space must be added to the building?
4. What will be the most economical and most feasible way to rearrange and remodel the various services and departments?
5. Will the planned modernization allow for future expansion?
6. Will structural features such as load bearing walls, stairs and elevators that cannot be relocated interfere with an optimum circulation pattern and improved space arrangements?

Mechanical Plant: Mechanical systems in hospitals represent a considerable investment and elements of existing systems that can be used in modernizing should be retained. However, in any modernization project, systems or elements of systems that lack capacity, are functionally obsolete, or have limited useful life should be replaced.

In many old hospitals, to compensate for changing conditions not foreseen in the original design, mechanical systems have been extended to accommodate renovated areas and additional equipment. These piecemeal extensions and additions have resulted in taxing the capacity of the equipment and systems to their limit or in overtaxing them. Renovation of the mechanical systems may be required to bring them up to standard for their present function, which would preclude the possibility of the present mechanical systems being used for additional areas or equipment. In this case, additional mechanical systems and equipment will be required to provide the necessary capacity for the expansion programed.

In the rearrangement or relocation of department and services, the removal, relocation and in some instances increase in capacity of mechanical systems will be difficult because service will probably have to be maintained during renovation, and many parts of the systems are buried in the structure and cannot be easily observed. The mechanical systems and equipment serving each hospital department should be carefully evaluated through personal discussion with, or written reports from, each department head and principal operating personnel and by a careful analysis of engineering drawings and maintenance records. Constant or frequently occurring deficiencies should be carefully examined and analyzed.

The primary facilities that require careful evaluation are the utility systems, both on-site and off-site; heating, ventilating, air-cooling and plumbing systems, and sterilizing, laundry and kitchen equipment. The mechanical evaluation should include careful consideration of the following areas:

Utilities: Deficiencies in water supply or pressure at the various fixtures or equipment may result from inadequate off-site and on-site mains and distribution piping within the facility. These piping systems should be evaluated relative to the present, proposed modernization, and anticipated future service requirements.

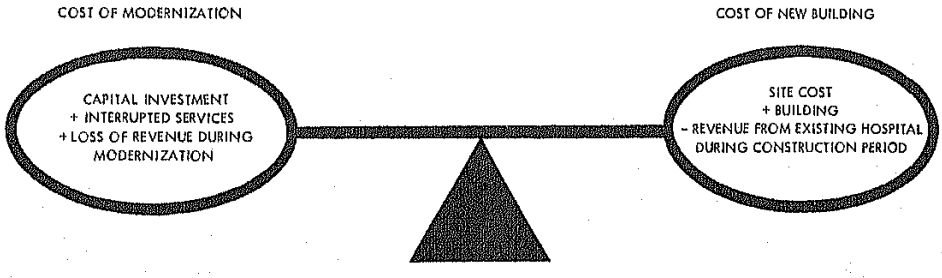
Improper drainage from fixtures and equipment may indicate inadequate drainage lines of the sewage system within the facility. Properly located cleanouts to facilitate maintenance of the systems should not be overlooked.

Modernization including additions to existing structures and increases in parking areas may overtax existing site drainage facilities.

Plumbing Systems: Any deficit in the number, type and quality of fixtures required for specific functions or the maintenance of aseptic technic in the existing structure should be corrected. Stains in fixtures may be one indication of obsolescence but, more importantly, may be an indication of improper water treatment and piping corrosion.

Of particular importance will be the capacities and physical condition of the many piping systems as they relate to present and projected loads under the program. Valving that controls the cut-off or zoning of particular sections of these systems will be important in maintaining service during modernization which may involve additions to these systems or the moving of partitions in which the riser piping serving upper floors is located.

Steam and Heating Systems: Economical operation and the provision of uninterrupted service presumes sufficient boiler capacity to serve the present and projected loads while maintaining standby capacity sufficient to maintain



Tipping the scales toward a decision to modernize or a decision to build are these cost factors which hospital planners need to consider.

service during unforeseen emergencies. An analysis of the present boiler capacity relative to the present and projected future loads should receive top priority.

Boiler insurance inspection reports will provide an excellent guide as to the physical condition of the boilers as well as to their capacity to handle present loads. The crowding of an additional boiler or of adjunct equipment into insufficient space, which will adversely affect operations and maintenance, should not be tolerated.

Proper ventilation providing air for combustion, which affects economy of operation, should not be overlooked in any modernization scheme. Fuel storage capacity may be inadequate when new boilers are required.

The heating system, whether steam, hot water, or air, should be carefully examined. Large cumbersome cast-iron radiators, which consume valuable space and act as collectors of dust and contamination, should be replaced. In most instances, modern cast-iron radiators, convectors and baseboard systems, when complemented with a ventilation system, will prove very satisfactory.

Careful attention should be given to the condition and capacities of steam piping systems serving equipment in areas such as central sterilizing and supply and substerilizing rooms when such areas are to be expanded and additional equipment is required. As noted under Plumbing Systems, the location of piping within walls will be of extreme importance.

Ventilation systems providing fresh air for the dilution and removal of odor and contamination as well as comfort are an accepted standard in modern hospitals. Many older hospitals, in some instances as the result of limited budgets, have attempted to correct particularly distressing conditions by resorting to improvised ventilation schemes, such as the window exhaust fan. Such improvisations, although they alleviate the immediate problem, very often lead to highly suspect conditions relative to fire safety and infection. Any modernization schemes should eliminate such improvisations.

In older hospitals, corridor ceiling heights in many instances will be sufficient to permit the installation of a suspended ceiling in the corridor above which duct systems can be installed to serve the individual rooms. Any modernization plan should examine the proximity of outdoor fresh air intakes to outdoor exhaust air outlets from the hospital. Any ventilation system that permits exhaust air from the hospital to re-enter the hospital by way of the fresh air inlet is not only hazardous but is a waste of operating money.

Only after careful engineering analysis of duct and fan capacities should any suggestion of additions to existing ventilation systems be considered.

Any modernization plan must consider air conditioning as a supplement, both physiologically as well as psychologically, to good patient care. Air conditioning presumes not only the regulation of temperature and humidity but also the provision of a bacteriologically suitable quality of air to the environment.

The removal of equipment that cannot provide a suitable ventilation rate or humidity control should be considered. However, with some systems the installation of a supplementary ventilation system properly designed with humidity controls may prove satisfactory. In some situations the installation of central air conditioning systems may not be feasible. Large package air conditioning units that may serve a complete department or floor through a conventional duct system are commercially available.

Sterilizing Laundry and Kitchen

REGIONAL COSTS OF TYPICAL HOSPITAL

Area	*Total Project Cost Per Sq. Ft.*	*Extent of Modernization and Additions*
Northeast	$44.00	Completion of unfinished 6th floor and new 7th floor added.
	$35.84	New ancillary service wing, new surgical and delivery suites, new x-ray and laboratory services, and extensive remodeling of existing facilities.
East	$47.21	New boiler plant, exponded kitchen facilities, and remodeling of x-roy and emergency suites, and surgery and recovery.
	$43.72	Addition of 5th and 6th floors to existing structure involving demolition of existing roof and penthouse and expansion of utilities to accommodate new floors.
Midwest	$30.00	New construction, 77,000 sq. ft.; remodeling, 96,000 sq. ft. Extension of elevators and dumb-waiters; remodeling and extension of boiler plant; new surgical, pediatric, newborn and premoture nursery, and air conditioning existing building.
	$30.00	New administration, loundry, loboratory, medical recards department, and pneumatic tube system and remodeling and air conditioning of existing building.
	$43.70	16 new beds added and 7,100 sq. ft. of remodeling throughout existing hospital.
West	$46.94	Includes 4,762 sq. ft. of remodeling, new nurses' call system, expansion of pneumatic tube system, air conditioning of three surgical suites, and 66 bed addition.
	$33.61	Additions to administration, medical records, emergency, x-roy, laboratories, surgery, central sterile supply, and remodeling of two floors of potient facilities in existing building.

Equipment: All sterilizing, laundry and kitchen equipment should be thoroughly evaluated for physical condition, expected life, and capacity.

Electrical System: Hospital electrical facilities become obsolete because of changes in code or safety requirements even though the original system is maintained in good order. Advances in medical technology and the associated concurrent development and use of equipment for these specific purposes, coupled with the increased use of all types of ordinary electric equipment, the addition of air conditioning, continually increasing use of various types of electronic equipment, higher levels of illumination, improved communication and signaling equipment, wear of machinery, fatigue and deterioration of electric insulation and control devices are some of the reasons why hospital electrical systems become obsolete.

Overloaded electrical conductors in addition to being a fire hazard are generally inefficient because of the associated voltage drop and line losses.

The electrical system should be thoroughly evaluated to determine the capacity of the present installation and its ability to adequately meet present needs and also the needs after the proposed alterations and additions are made, plus allowance for future load growth estimated on past performances. Among the important items to be evaluated and some of the questions to be considered in relation to each are the following:

Voltage and capacity of the public utility service supplied to the hospital must be studied. If a new service line is needed, what alteration to building, grounds or landscaping will be required?

Are the step-down transformers owned by hospital or utility company? Are they located inside or outside the building? If located in the building, are they air-cooled or nonflammable liquid-cooled? Are they presently overloaded at maximum demand? If not, do they have sufficient space capacity to supply the hospital after completion of proposed alterations or additions? If they must be replaced, what cost and alterations would be involved?

Do the present distribution panels have sufficient capacity to supply the connected load? Are feeder circuits properly protected against overloads? Is the present distribution center arranged in a neat orderly fashion conducive to good housekeeping, or has an added number of switches and subfeeders cluttered the area so that it is advisable to install a new distribution center replacing these various panels and switches?

Do the present circuit breakers have sufficient current carrying capacity; also, do they have the recommended interrupting ampere rating?

Are there exposed wiring extensions that should be reinstalled to reduce dust catchers and improve esthetics?

Is there apparent deterioration of conductor insulation in some areas that indicates poor dependability of the existing wiring?

Will proposed architectural remodeling require relocating existing electric lines and outlets?

Are additional electrical outlets, or outlets of a different type, needed in any of the various service and patient

EXTENSIONS AND REMODELING

Area	Total Project Cost Per Sq. Ft.	Extent of Modernization and Additions
Northwest	$35.80	Remodeling 5,000 sq. ft. of existing hospital.
	$32.50	Addition for administration and laboratory and extensive remodeling of nursery and pediatric units.
	$45.90	New surgery, recovery, central supply, and kitchen facilities and extensive remodeling in existing building.
Southwest	$31.60	Remodeling of existing building and a vertical extension of five floors and a new five-story wing for ancillary services.
	$32.44	Enlarged kitchen facilities; extension of facilities for central sterile supply; expansion of physical therapy facilities; and new nurses' call system and air conditioning.
	$32.94	Addition for administrative and central supply service and boiler plant and remodeling of dietary, recovery, medical records, maintenance shops, and other ancillary services.
South	$56.83	Remodeling of existing building to add space for medical records, new morgue, expanded dietary department, administrative area, laboratory and central supply, and vertical addition of three stories and necessary extended utilities including air conditioning
	$35.33	New storage facilities, new x-ray a gency operating room, and moderni medical library, pharmacy, chapel mitting service area.
Southeast	$31.69	25 bed addition and modernization ing hospital.
	$32.96	Remodeling to provide additional administrative and emergency area

ing met in anesthetizing areas and in storage areas for medical gases? Is an ungrounded wiring system and associated ground contact indicator of the required performance characteristics installed?

If mobile x-ray is used in the operating rooms, is it explosionproof, and are there proper outlets installed for its connection?

If either radio or television is used in patient areas, are suitable antennas provided? Is closed-circuit TV presently used, or planned to be used, in such areas as operating rooms or for teaching purposes?

Present and anticipated future installations for the use of electronic monitoring and diagnostic equipment should be carefully reviewed for suitability of space and wiring installations. Is a shielded room needed for satisfactory use of any of the highly sensitive electronic equipment?

Are the occupied areas adequately protected against ionizing radiation emanating from x-ray or sealed gamma source teletherapy equipment?

Are telephone services, nurses' call, paging systems, and public address systems sufficient and meeting needs satisfactorily?

Are all alarm systems that are required, or needed, installed, and functioning properly? Consideration should be given to fire alarms, medical gas quantity alarm systems, fire and smoke detecting systems.

Is the capacity of the emergency electrical system sufficient to supply the lighting and power requirements during the time the normal power supply is interrupted: (1) at present? (2) after proposed alterations?

Are there suitable space and sufficient meters, replacement parts, and maintenance materials of the various types provided for electrical testing and maintenance?

Are the present elevators sufficient in number, size and type to adequately meet present needs? If larger elevators are needed, is the present shaft size large enough to accommodate the larger size needed? Are dumb-waiters installed where needed?

Structural and Fire Safety Considerations: The existing building should be carefully inspected to make sure that it will support the programed remodeling both structurally and from the standpoint of fire safety of the modernized facility. The structural evaluation is important because:

1. Deterioration may have impaired the structural adequacy of building elements. Inspection is required to ascertain if any deterioration can be economically repaired or replaced.

2. Today's hospital equipment and supplies have structural requirements which greatly exceed those of the past. Therefore, the structural loading conditions may be substantially greater. This is particularly true where numerous partition changes are proposed.

3. Up-to-date mechanical and electrical services will require numerous openings in structural slab construction. Some older structural systems cannot accommodate these openings without sacrifice of structural adequacy. Other structural systems severely limit the location and size of openings that can be used. Thus, an existing structure can force a designer to accept serious compromises in a new project unless the structure is strengthened, which can be very costly.

4. The need for adequate space for distribution lines of heating, ventilating, plumbing, electrical and communication services in the plenum area between the ceiling and floor construction should be recognized. Without adequate clear space for these services, modernization will be extremely costly, maintenance and repair service will be difficult, and flexibility to permit replacement to meet future needs will be jeopardized.

Life safety from fire can only be achieved by a studied combination of several important design considerations discussed below:

1. All combustible construction that would affect the structural integrity of the building in case of fire or that would promote the rapid spread of fire should be removed. Combustible wall paneling and acoustical tile are serious problems in life safety from fire.

2. Many older buildings are provided with inadequate or substandard building fire alarm systems and provision for upgrading the fire alarm system should be considered in the remodeling phase of the building. Hazardous areas of a hospital, such as large storage rooms that contain combustible supplies, maintenance shops, laundries, boiler rooms, and trash collection rooms, should be provided with an automatic sprinkler system. This is recommended because, in case of fire in one of these locations, such a system discovers the fire, supplies an extinguishing medium, and sounds an alarm as well. It would be desirable to install an automatic system in corridors of basement and other areas which are not under constant supervision.

3. Because of the human element, fires will occur in hospital buildings. To prevent major catastrophies in hospital fires, all possible precautions to confine the fire to its point of origin should be taken. Wood panel doors should be replaced with heavy solid type doors, and louvers and ventilating transoms in interior partitions should be sealed. View windows in corridor walls should be of wire glass set in steel frames.

Each floor should be compartmented by a tight partition that extends throughout concealed plenum spaces from wall to wall and from floor to floor, with smoke-tight doors where the partition cuts across corridors.

All vertical shafts that pass through the building should be completely enclosed to prevent smoke and fire gases from spreading from floor to floor. These would include stairways, elevator shafts, dumb-waiter and similar shafts, utility chases, and laundry and trash chutes. Fire doors should be used for any opening into these shafts.

4. Many existing hospitals are not properly equipped with portable fire extinguishers to permit the occupants to cope with the fire at an early stage. Several types of extinguishers are available. For guidance on their selection and distribution within the hospital, the local fire-fighting organization should be consulted.

5. Improper exit facilities have been blamed for much loss of life in institutional fires. Wide door openings and wide corridors should be used because patients may have to be removed from the building by stretcher, wheel chair, or even on a bed. Stairways should be located at or near the end of each corridor to prevent entrapment of occupants in dead ends. Also, stairways should be arranged to lead directly outside the building at grade level or to a safe passage which has convenient access to the street.

Construction Costs: Studies by the Public Health Service show that unit costs for modernization in many instances are greater than for new construction.

The 1964 national average cost for building and fixed equipment for new hospital construction was $27 per square foot whereas the minimum cost for extensive remodeling of an existing facility or additions was $30 per square foot. However, although the square foot cost of remodeling may be higher than that for new construction, the entire cost of the project should be carefully analyzed. It may be that the total cost for the necessary remodeling would be less than the total cost of constructing a new facility.

In estimating the cost of renovations and additions, it may be interesting to note that the square foot cost varies with the different departments in the hospital. Departments such as surgery and x-ray may cost more per square foot than such areas as corridors, storage and administration. The study, Estimating Space Needs and Costs in General Hospital Construction,[2] will be helpful in estimating the costs of these areas.

The tabulation on pages 94 and 95 gives some representative costs for remodeling and additions in various sections of the United States.

Other Costs: The cost of modernization includes hidden costs that are not always recognized as part of the capital investment cost. Some of these are: (1) loss of revenue because of interruption of "business-as-usual" during the construction phase, and (2) loss of revenue because the time required for modernization is usually longer than that required for construction of a new facility.

On the other hand, factors involved in the cost of new construction would be: (1) the dollar value of the old facility when a new hospital appears to be the best answer, and (2) the continuing revenue from the existing hospital during construction of the new facility. The existing facility will, undoubtedly, have some value depending upon its location, condition, and the real estate situation in the area. This "salvage value" may be a considerable amount and should certainly be included in the economical study as a part of the feasibility survey.

Specifications and Contracts

Because of the additional complexities inherent in a remodeling project, responsibility for drawings and specifications should be assigned to experienced architects and engineers. Plans and specifications must describe the existing conditions and the scope of the project in detail, so that the contractor can prepare a realistic bid.

A complete construction schedule should be part of the specifications upon which contractors base their bids. If possible, the plans should show when each area to be modernized should be completed and ready for use. Many hospital administrators hope that business can go on as usual during construction, but this is rarely possible. With careful planning, however, the interference of construction activity can be minimized, but schedules must be worked out well in advance. The contractor may have to complete certain departments or portions of the work before going on to other departments rather than to complete the work by trade, as is usually the procedure.

When modernization of an existing facility comprises the largest part of a project, special consideration should be given to the type of construction contract to be used. Here, the usual lump sum contract that works well for new construction, where all the job requirements can be accurately determined and described by the architect, is often not the best contract because of unforeseen and difficult working conditions. Many change orders are inevitable in renovation projects.

On projects involving extensive modernization, a guaranteed limit-of-cost contract with a return of savings provision might be of advantage to the owner. Under this form of contract, which should not be confused with a cost-plus contract, the contractor guarantees that the lump sum price, quoted in his bid, will not be exceeded and the owner and the contractor share in the amount the actual cost underruns the lump sum price.

The price quoted by the contractor includes his best estimate for the work according to the plans and specifications and a stipulated sum which includes his fee for supervision, overhead and profit. On Hill-Burton projects, bids for such contracts could be taken competitively either by public advertising to all qualified bidders or by selective bidding where three or more qualified contractors are invited to submit proposals.

Guaranteed limit-of-cost contracts are complicated to administer since close supervision and detailed accounting by both the owner and the contractor are required. For this reason, it is advantageous to the owner to have only one prime contractor since he assumes the responsibility for coordinating the activities of all other contractors.

In preparing this paper, we have not presumed to tell the owners, the architects, and the other members of the planning team how to solve each problem they will encounter. We have, however, tried to describe the scope of the over-all problem, explain some steps that will help in its solution, and encourage those concerned to view modernization questions with objectivity. ■

[2]Souder, James J.: Estimating Space Needs and Costs in General Hospital Construction. Chicago: American Hospital Association, 1963, pp. 32.

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